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A Survey on Image Feature Descriptors-Color, Shape and Texture

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Abstract: **Content-based image retrieval, a technique which uses visual information to search images from large scale image databases according to users' interests. Image retrieval is one of the most exciting and efficient growing research areas. The visual content of an image is analyzed in terms of low-level features extracted from the image. The retrieval result based on simply linear combined low level features is better than only based on single visual feature. In this paper we extract color, texture and shape features from the Image.The extracted features are described by feature vectors. Compare the query image feature with target image feature and select most similar image from the large database. Inthis survey paper, various popular algorithms for feature extraction are considered.**

***Keywords*-Content Based Image Retrieval, Color extraction, texture extraction, shape extraction, Similarity Measure and Feature Combination.**

1. INTRODUCTION

CBIR techniques automatically extract low-level features (e.g. color, texture, shapes and layout of objects) to measure the Similarities among images by comparing the feature differences. A key function in any CBIR system is the feature extraction [5]. Feature extraction is the process of mapping the image pixels into the feature space. The features extracted are used to represent images for searching, browsing and indexing images in an image database. Use of feature space is more efficient in terms of storage and computation. The CBIR systems represent the feature space as a feature vector. The features are represented as a vector and it can be used to determine the similarity between images. The similarly measure is used to determine the distance between the query image and stored images. After that images are ranked according to the distance and retrieved.

In this paper, we represent images by color, texture and shape descriptors. Common color descriptors are color histogram, color moments and color coherent vector. color histogram performs well compared to other s descriptors when images have mostly uniform color distribution.

Texture is also an important visual feature that refers to innate surface properties of an object and their relationship tothe surrounding environment. Many objects in an image canbe distinguished solely by their textures without any other information. Commonly used texture descriptors are Gray level co-occurrence matrix, Gabor wavelet feature. There are several measures in texture feature comparison such as the degree of contrast, coarseness, directionality and regularity, or periodicity, directionality and randomness.

Shape feature is more effective in characterizing the content of an image, compared the other features like texture and color. Methods for representing and describing shapes can be divided into two groups: external methods, which represent the region in term of its external characteristics (its boundary), and internal ones, which represent the region in terms of its internal characteristics (the pixels comprising the region).Mainly the shape features are classified in to two types: boundary descriptors and region descriptors. Further they are classified as (a) Structural and (b) global. The global boundary descriptors include various Fourier descriptors, signatures and wavelet descriptors.

In this paper, we extract images from the large databases according to color, shape and texture features. Most efficient descriptors are used for each feature. Compare the query image feature with target image feature and select most similar image from the large database. Different feature extraction methods and similarity measures are used.

2. RELATED WORK

Traditional methods of image retrieval are based on associated Meta data such as keywords and text. It have some critical problems such as lack of appropriate data, limitation to express the visual content of the image, incorrect metadata etc..Most of the image retrieval systems are based on single feature, commonly used feature is the color of the image. using single feature methods ,the retrieval results are not exact and efficient.

AvneetKaur, V. K. Banga proposed a image retrieval system based on color feature. For color based image retrieval, color can also be represented by numerous of ways. Most commonly used color descriptors are: Color moments, color histograms, color coherence vector, color correlogram. There are various ways to calculate the similarity distances. Commonly used similarity measures are Minkowski and Quadratic distances. Dimension reduction isusually performed to reduce the dimensionality of the visual feature vector, Principal component Analysis (PCA) is commonly used for dimension reduction. Query results can be refined through therelevance feedback of users.

Qiang Zhao, Jie Yang[3] developed a image retrieval technique based on color histograms. In this paper images color features are chosen for itsretrieval and indexing.

Different color histograms like Cross color histogram, annular color histogram, and angular color histogram are Respectively combined with HSV color space to accord withhuman's visual uniformity. Experiments showed that cross color histogram in HSVcolor space has excellent performance on images retrieval.

Ch.Kavitha,Dr.B.PrabhakaraRao, Dr.A.Govardhan[4] proposed image retrieval system based on color and texture. In this paper, image is portioned into sub-blocks of equal size. for each sub-block construct cumulative HSV color histogram. Texture of each sub-block is obtained by using gray level co-occurrence matrix. A one to one matching scheme is used to compare the query and target image.

ManimalaSingha,K.Hemachandran[6] presented a novel approach for Content Based Image Retrieval by combining the color and texture features called Wavelet-Based Color Histogram Image Retrieval (WBCHIR). Similarity between the images is calculated by means of a distance function. The texture and color features are extracted through wavelet transformation and colorhistogram. The system has developed a promising and faster retrieval method.

K.NareshBabu, Dr.K Ashok Babu[5] proposed a system based on color, texture and shape. In this system, they used HSI color information especially Hue value and CSS (Curvature Scale Space)as shape information. Different feature extraction methods and matching measures are used in this system.

Haralick RM discussed the four image features are extracted by this system, which are color feature (HSV color histogram), texture feature (co-occurrence matrix), shape feature (moment invariant based-onThreshold optimization), spatial relationship feature (based-on the Markov chains). By using feature weight assignment operators designed here, the method can assign weight to color and texture features according to image content adaptively and realize image retrieval based on combined image features. The retrieval results are more exact and efficient than other methods based on single feature and simple linear combined features of fixed weight, the retrieval results are more suitable to the human visual characteristic. The error matching is decreased and weight assignment is logical.

3. CBIR SYSTEMS

A. Principle of CBIR

Content-based image retrieval is an application of computer vision, used to retrieve images from the large database. "Content-based" means that the search analyzes the contents of the image rather than the metadata such as keywords, tags, or descriptions associated with the image. The term "content" in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself.Fig.1. Shows architecture for content-based image retrieval. The general architecture of CBIR system is shown in figure. Features are extracted from individual images and stored in the feature database. There are various types of like color, texture, shape, region or spatial features or some compressed domain features. The extracted features are described by feature vectors. This feature vectors are then stored to form image feature database.

Extract the features of query image and form a feature vector for the corresponding image.. This feature vector is matched with the already stored vectors in image feature database. Sometimes dimensionality reduction techniques are employed to reduce the computations. The distance between the feature vector of the query image and those of the images in the database is then calculated.

The distance of a query image with itself is zero if it is in database.The distances are then stored in increasing order and retrieval is performed with the help of indexing scheme.

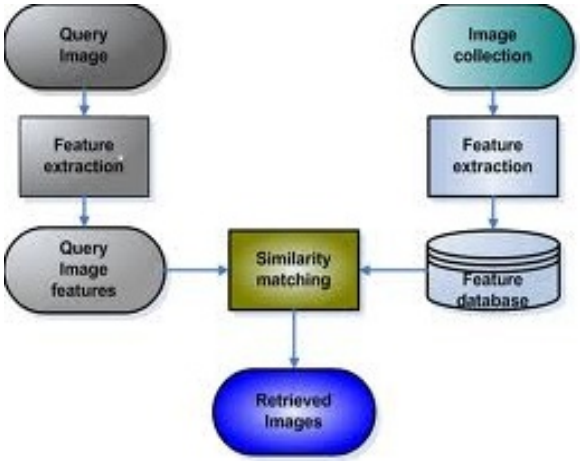

Fig. 1 The Architecture of CBIR system

B. Color Feature Extraction

Color is the first and most straightforward visual feature for indexing and retrieval of images. Most commonly used color descriptors are color moments, color histograms, color coherence vector and color correlogram. Colour plays very important role in the human visual perception mechanism. All methods for representing color feature of an image can be classified into two groups: color histograms and statistical methods of color representation. The most frequently used color spaces are as follows: RGB (red, green, and blue), CMY (cyan, magenta and yellow), CMYK (cyan, magenta, yellow, and black), Lab (lightness, a and b are two color dimensions) HSI, HSV (hue, saturation, and value). Two major methods used frequently in CBIR which are; normal color histogram using GLCM, and color histogram using KMeans [6]. Using Euclidean distance, similarity between queried image and the target images are calculated. Previous studies Shows that color histogram with K-Means method had high accuracy and precise compared to GLCM.

Color features for retrieval of image

Color features	Advantages
Color Space	widely used for digital image display
Color Moments	compact features of color and sensitive to spatial information
Color Coherence Vector	More efficient results
Color Histogram	Extracts both local and global features of colors

C. Texture Feature Extraction

Texture gives us information on structural arrangement of surfaces and objects on the image. It depends on the distribution of intensity over the image, not defined for a separate pixel.

The most commonly used statistical features include, parameters calculated based on the co-occurrence matrices, general statistical parameters calculated from pixels intensity values, texture histograms built upon the Tamura features. Grey level co-occurrence matrices (GLCM) proposed by Haralick is one of the method for representing texture features of images.

Texture analysis by means of the Gabor filters is a special case of the wavelet approach. This is the most frequently used method in image retrieval by texture. In most of the CBIR systems based in Gabor wavelet, the mean and standard deviation of the distribution of the wavelet transform coefficients are used to construct the feature vector. A new feature scheme called enhanced Gabor wavelet correlogram (EGWC) is proposed for image indexing and retrieval.

Texture features for image retrieval

Texture features	Advantages
Gabor filter	Used to detect different Frequencyand orientation.
Wavelet transform	Filters with salient Pointfeatures, efficient for retrieval.
Tamura	Provides effective result

D. Shape Feature Extraction

Shape of objects is also often used for image comparison, along with color and texture features. For representing shape of the image, various methods are used. It is divided into two groups: external methods (which represent the boundary) and internal ones (which represent the pixels comprising the region). Shape features are classified in to two types: boundary descriptors and region descriptors. Further they are classified as (a) Structural and (b) global. The global boundary descriptors include various signatures, Fourier descriptors and wavelet descriptors. Regions can be described in terms of simplest geometrical parameters, such as an area or compactness.

Grid based method is the commonly usedmethod for description of object shape.Moment invariants are currently the most popular and widely used region descriptors.

Shape features for image retrieval

Shape features	Advantages
Fourier descriptor	Fast Fourier Transformation used for efficient results
Axisorientation and Eccentricity	Increased the user interaction

E. Similarity Measure and Feature Combination

For each image color, texture and shape features are extracted and stored in the database. The extracted features are described by feature vectors. For a given query image, we similarly extract its features and form a feature vector. This feature vector is matched with the already stored vectors in image feature database. Sometimes dimensionality reduction techniques are employed to reduce the computations. The distance between the feature vector of the query image and those of the images in the database is then calculated. The distance of a query image with itself is zero if it is in database. The distances are then stored in increasing order and retrieval is performed with the help of indexing scheme. A one to one matching scheme is used to compare the query and target image.

There are various combining methods, like linear combining method, rank- based method, and BP-based method and Neural Network-based Image Retrieval (NNIR).

4. CONCLUSION

This paper has surveyed the essential concepts of content-based image retrieval systems. Image has various features, such as color, texture and shape. Combining low level features in retrieval has lots of advantages. The retrieval results are more exact and efficient than other methods based on single feature. Error matching is decreased and weight assignment is logical. Different visual features of images are discussed along with different feature extraction methods.

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